

High-Efficiency, Ka-Band Solid-State Power Amplifier Utilizing GaN Technology, Phase I

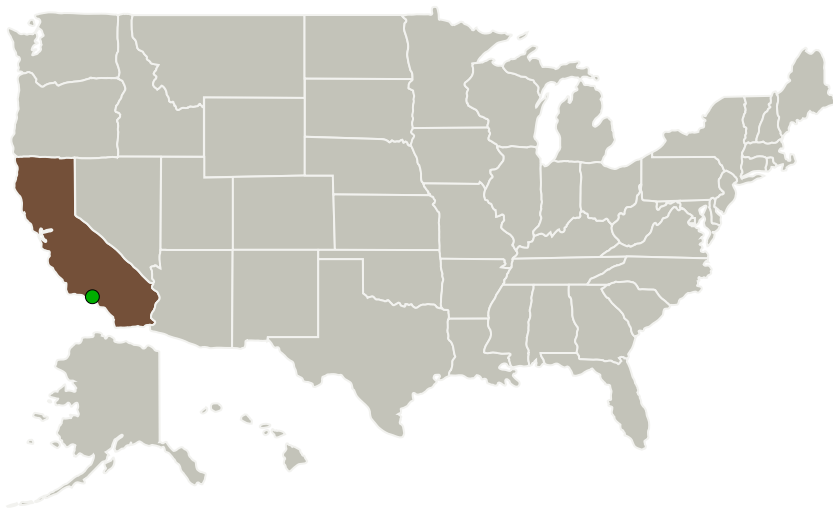
Completed Technology Project (2014 - 2014)



Project Introduction

QuinStar Technology proposes to develop an efficient, solid-state power amplifier (SSPA), operating at Ka-band frequencies, for high data rate, long range space communications. Specifically, we propose to develop a 20 W power amplifier with an associated PAE of 60% operating over the 31.5 to 34 GHz band. This will be accomplished by employing two major innovations. First, we plan to utilize wide bandgap Gallium Nitride (GaN) on Silicon Carbide (SiC) device technology. Operating at a higher voltage (typically 20-28 V versus 4-5 V for GaAs), GaN permits power densities which are 5-10 times higher than GaAs or InP. In addition to the power density, high-voltage operation results in lower matching and cell combining losses, making these MMICs more efficient. Secondly, we are proposing to utilize a switching mode (Class F) to enhance the device efficiency. While this method has demonstrated PAE levels of >80% at 2 GHz, it has not yet been demonstrated at Ka-band. Computer simulations, contained in this proposal, indicate that by using this method, PAE levels ranging from 65% to 80% are possible. This was verified by device models from three different foundries. Finally, we will utilize our high-efficiency, H-tee combiner technology to combine 4 of these chips to achieve 20 W output power.

Primary U.S. Work Locations and Key Partners



High-Efficiency, Ka-Band Solid-State Power Amplifier Utilizing GaN Technology, Phase I

Table of Contents

Project Introduction	1
Primary U.S. Work Locations and Key Partners	1
Project Transitions	2
Images	2
Organizational Responsibility	2
Project Management	2
Technology Maturity (TRL)	2
Technology Areas	3
Target Destinations	3

High-Efficiency, Ka-Band Solid-State Power Amplifier Utilizing GaN Technology, Phase I

Completed Technology Project (2014 - 2014)



Organizations Performing Work	Role	Type	Location
Quinstar Technology, Inc	Lead Organization	Industry Small Disadvantaged Business (SDB)	Torrance, California
● Jet Propulsion Laboratory(JPL)	Supporting Organization	NASA Center	Pasadena, California

Primary U.S. Work Locations

California

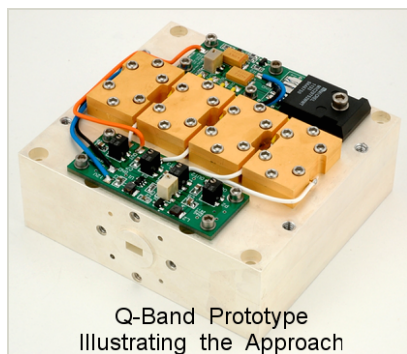
Project Transitions

**June 2014:** Project Start**December 2014:** Closed out

Closeout Documentation:

- Final Summary Chart(<https://techport.nasa.gov/file/140563>)

Images



Briefing Chart

High-Efficiency, Ka-Band Solid-State Power Amplifier Utilizing GaN Technology, Phase I
(<https://techport.nasa.gov/image/127376>)

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

Quinstar Technology, Inc

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

Program Manager:

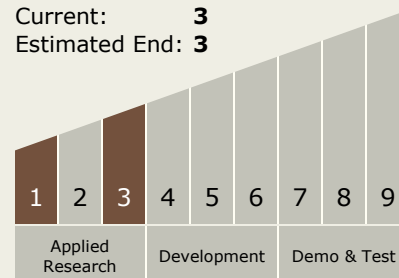
Carlos Torrez

Principal Investigator:

James Schellenberg

Technology Maturity (TRL)

Start: **1**
Current: **3**
Estimated End: **3**



High-Efficiency, Ka-Band Solid-State Power Amplifier Utilizing GaN Technology, Phase I

Completed Technology Project (2014 - 2014)



Technology Areas

Primary:

- TX05 Communications, Navigation, and Orbital Debris Tracking and Characterization Systems
 - └ TX05.2 Radio Frequency
 - └ TX05.2.2 Power-Efficiency

Target Destinations

The Moon, Mars, Outside the Solar System, The Sun, Earth, Others Inside the Solar System